Chapter 2 discussed how water quality is a reflection of the land use in the watershed. However, the condition of land within and along the stream channel is also critical to the health of the stream and its ability to support aquatic life.

What is a Healthy Stream Habitat?

A natural stream channel does not flow in a straight line; it meanders. Rivers meander as they flow because this pattern releases the kinetic energy of the water in the most even or uniform manner. Meanders also provide a variety of habitats for many species of plants and animals. Pools, riffles, undercut banks and snags (fallen limbs or small log piles) all provide different types of habitat. The more types of habitat present in a stream system, the greater the potential for aquatic plant and animal diversity.

A uniformly straight or deep channel provides less potential habitat than a stream with variable flows and depths. Examples of healthy and unhealthy stream habitats are shown in Figure 8 and 9.

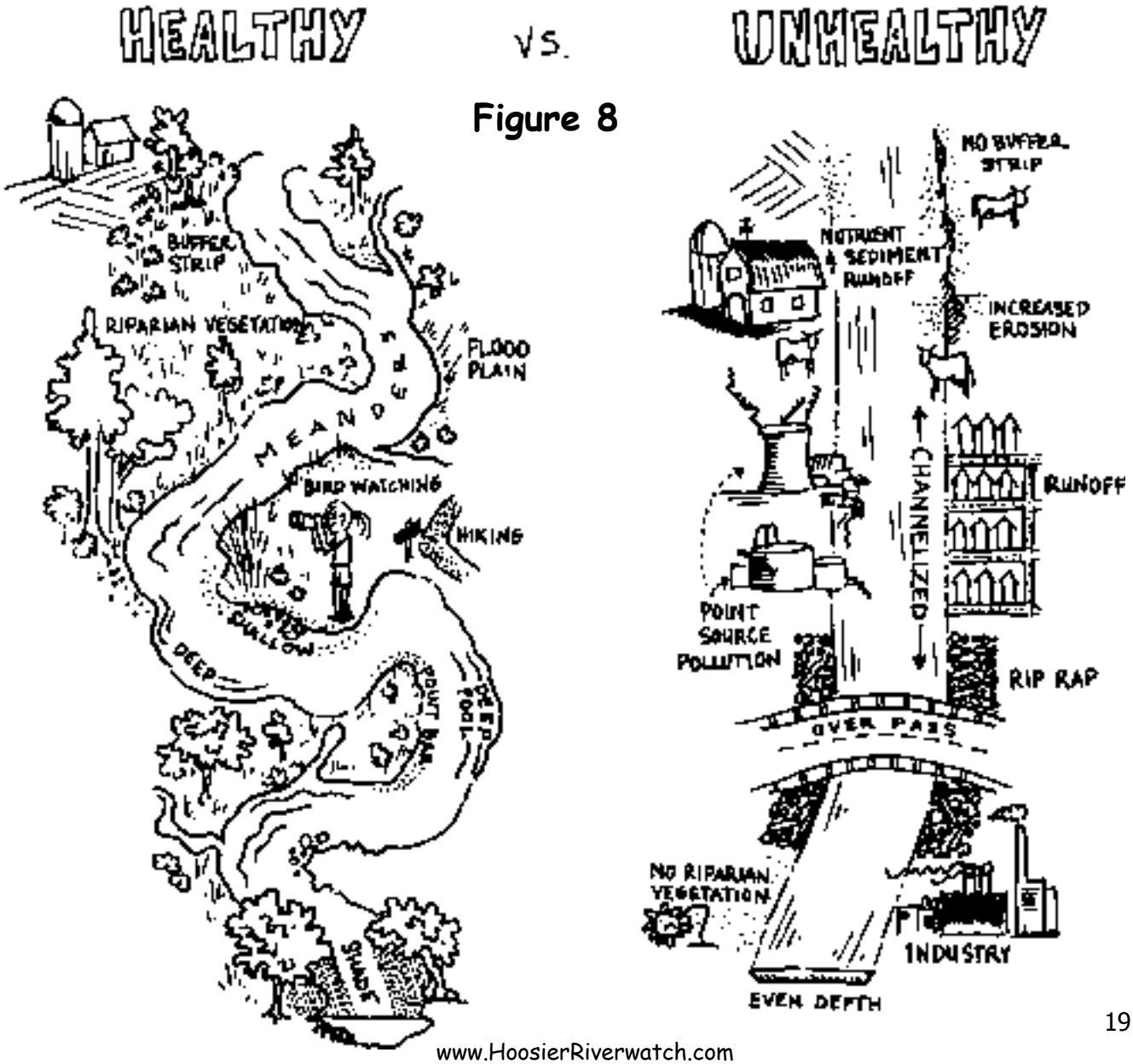


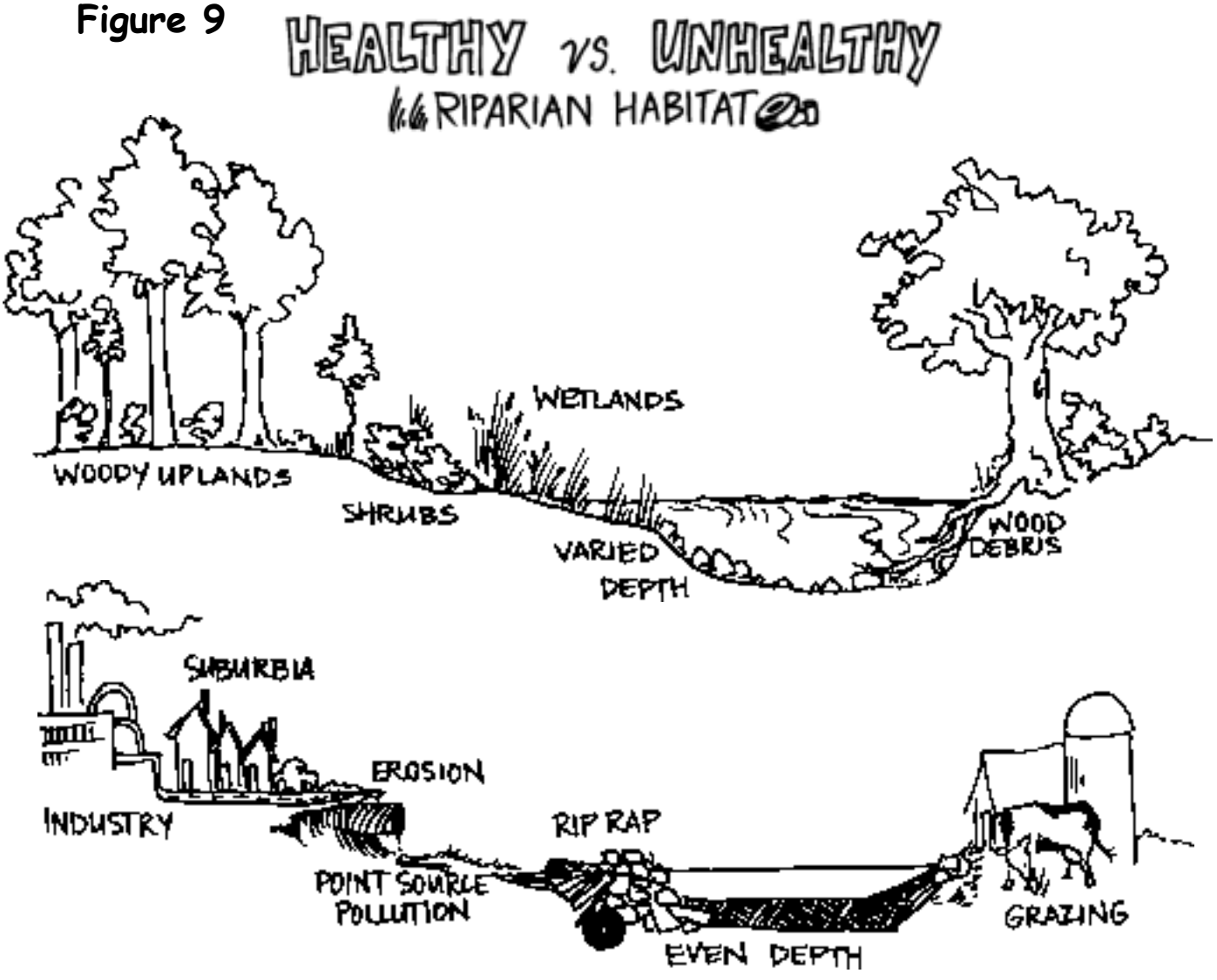
Figure 8

What is the riparian zone?

The term "riparian zone" refers to the areas adjacent to stream channels (see Figure 8). The riparian zone is the strip of land between the stream channel and upland hills. Stream riparian zones form an important transition zone between land and freshwater systems. Riparian vegetation refers to the plants that occur naturally on stream banks and along stream channels.

Streamside vegetation and wetlands are important components of a stream ecosystem because they provides streams with bank support and stabilization, erosion and flood control, water quality protection, fish and wildlife habitat, and scenic beauty. Plant roots bind soil to stream banks and reduce erosion, and deflect the cutting action of swift flowing stormwater, expanding surface ice, and strong winds. Streamside vegetation keeps the water cool by providing shade, and it provides habitat for aquatic and terrestrial creatures. In addition, plant litter that falls in upland streams is a major source of food for organisms in the stream. *(From the "Streamwalk Training Manual," Thames River Basin Partnership Initiative.)*

Figure 9



Citizens Qualitative Habitat Evaluation Index (CQHEI)

This index was developed by the Ohio Environmental Protection Agency as a "Citizens" companion to the Qualitative Habitat Evaluation Index (QHEI) used by the state's professional staff. The data sheet and diagrams on pages 22-23 were modified from information provided by the Ohio EPA. The purpose of the index is to provide a measure of the stream habitat and riparian health that generally corresponds to physical factors affecting fish and other aquatic life (i.e. macroinvertebrates). The CQHEI produces a total score that can be used to compare changes at one site over time or compare two different sites.

NOTE: The CQHEI data sheet was designed to be used primarily in wadeable streams. The index scores do not necessarily reflect the conditions found in intermittent streams or large rivers.

When completing the CQHEI, evaluate your entire stream site (200' section).

In each category chose the most predominant answer. If sections of the stream or stream banks have completely different characteristics, you may check two boxes and average the points to obtain a score for the subsection (a), (b), or (c). An example is provided on page 24.

I. Substrate (Bottom Type) - Max 24 pts

II. Fish Cover (Hiding Places) - Max 20 pts

Select all the cover types that you see using the diagrams on page 22 as a guide. Add the points. (Note: "smothering" is the same as "embeddedness." See Figure 7 on page 13. Check "yes" for smothering, if the steam bottom is more than 50% embedded.)

III. Stream Shape and Human Alterations - Max 20 pts

IV. Stream Forests and Wetlands (Riparian Areas) & Erosion - Max 20 pts

a) Width of the Riparian Forest or Wetland - **This is not the width of the stream!** Estimate the width of the area containing **trees** or **wetlands** on each side of the stream by answering: "Can you throw a rock to the other side?"

b) See Appendix C-2 for a description of conservation tillage.

V. Depth & Velocity - Max 15 pts

a) Deepest Pool - If your stream is a consistent depth, select the maximum depth.

b) Select all the flow types that you see and add the points.

VI. Riffles/Runs (where the current is turbulent) - Max 15

Using the lower diagrams on page 22 as a guide.

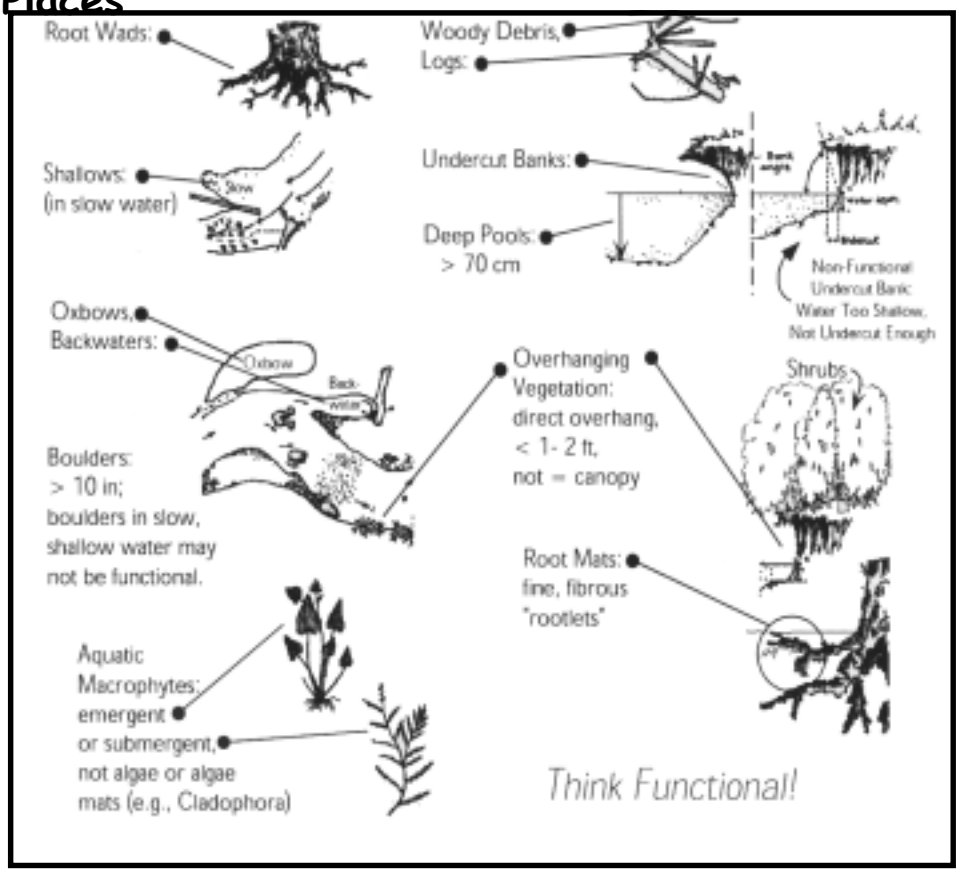
MAXIMUM TOTAL POINTS FOR THE CQHEI IS 114.

If the score is over 100, consider it "extra credit."
You have an exceptional high-quality stream.

A set of ranges for
Excellent, Medium, Poor, Very Poor
has not yet been developed for this index - but,

QHEI scores > 60 have been found to be
"generally conducive to the existence of warmwater fauna."

CQHEI Section II: Fish Cover "Hiding Places"



CQHEI Sections V & VI: Depth and Velocity and Riffles and Runs

Riffle and Run Habitats:

Riffle - areas of the stream with fast current velocity and shallow depth; the water surface is visibly broken.

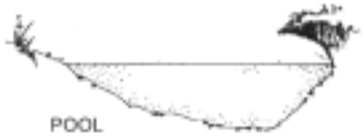
RIFFLE

Run - areas of the stream that have a rapid, non-turbulent flow; runs are deeper than riffles with a faster current velocity than pools and are generally located downstream from riffles where the stream narrows; the stream bed is often flat beneath a run and the water surface is not visibly broken.

RUN

Pool and Glide Habitats:

Pool - an area of the stream with slow current velocity and a depth greater than riffle and run areas; the stream bed is often concave and stream width frequently is the greatest; the water surface slope is nearly zero.



POOL

Glide - this is an area common to most modified stream channels that do not have distinguishable pool, run, and riffle habitats; the current and flow is similar to that of a canal; the water surface gradient is nearly zero.

GLIDE

HINT: These habitat types typically grade into one another. For example a run gradually changes into a pool.

Date: _____

Citizens Qualitative Habitat Evaluation Index

CQHEI Total: _____

Vol ID: _____ Site ID: _____ River and Watershed: _____

I. Substrate (Bottom Type) Score: _____

a) Size

- ☐ 14 pt — Mostly Large (Fist Size or Bigger)
- ☐ 10 pt — Mostly Medium (Smaller than Fist, but Bigger than Fingernail)
- ☐ 6 pt — Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock)
- ☐ 0 pt — Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky)

b) "Smothering"

- ☐ NO 5 pt — Are Fist Size and Larger Pieces Smothered By Sands/Silts?
- ☐ YES 0 pt — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects

c) "Silting"

- ☐ NO 5 pt — Are Silts and Clays Distributed Throughout Stream?
- ☐ YES 0 pt — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two

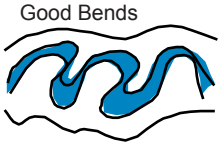
II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present Score: _____

- ☐ 2 pt — Underwater Tree Roots (Large)
- ☐ 2 pt — Underwater Tree Rootlets (Fine)
- ☐ 2 pt — Boulders
- ☐ 2 pt — Backwaters, Oxbows or Side Channels
- ☐ 2 pt — Downed Trees, Logs, Branches
- ☐ 2 pt — Shallow, Slow Areas for Small Fish
- ☐ 2 pt — Water Plants
- ☐ 2 pt — Deep Areas (Chest Deep)
- ☐ 2 pt — Undercut Banks
- ☐ 2 pt — Shrubs, Small Trees that Hang Close Over the Bank

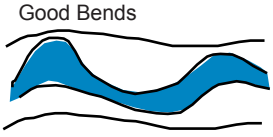
III. Stream Shape and Human Alterations Score: _____

a) "Curviness" or "Sinuousity" of Channel

- ☐ 8 pt — 2 or More Good Bends



- ☐ 6 pt — 1 or 2 Good Bends



- ☐ 3 pt — Mostly Straight Some "Wiggle"

- ☐ 0 pt — Very Straight

b) How Natural Is The Site?

- ☐ 12 pt — Mostly Natural
- ☐ 9 pt — A Few Minor Man-made Changes (e.g., a bridge, some streambank changes)
- ☐ 6 pt — Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders)
- ☐ 0 pt — Heavy, Man-made Changes (e.g., leveed or channelized)

IV. Stream Forests & Wetlands (Riparian Area) & Erosion Score: _____

a) Width of Riparian Forest & Wetland - Mostly:

- ☐ 8 pt — Wide (Can't Throw A Rock Through/ Across It)
- ☐ 5 pt — Narrow (Can Throw A Rock Through/ Across It)
- ☐ 0 pt — None

b) Land Use - Mostly:

- ☐ 5 pt — Forest/Wetland
- ☐ 4 pt — Shrubs
- ☐ 3 pt — Overgrown Fields
- ☐ 2 pt — Fenced Pasture
- ☐ 2 pt — Park (Grass)
- ☐ 2 pt — Conservation Tillage
- ☐ 1 pt — Suburban
- ☐ 1 pt — Row Crop
- ☐ 0 pt — Open Pasture
- ☐ 0 pt — Urban/ Industrial

c) Bank Erosion - Typically:

- ☐ 4 pt — Stable Hard or Well-Vegetated Banks
- ☐ 2 pt — Combination of Stable and Eroding Banks
- ☐ 0 pt — Raw, Collapsing Banks

d) How Much of Stream is Shaded?

- ☐ 3 pt — Mostly
- ☐ 2 pt — Partly
- ☐ 0 pt — None

V. Depth & Velocity Score: _____

a) Deepest Pool is At Least:

- ☐ 8 pt — Chest Deep
- ☐ 6 pt — Waist Deep
- ☐ 4 pt — Knee Deep
- ☐ 0 pt — Ankle Deep

b) Check ALL The Flow Types That You See (Add Points):

- ☐ 2 pt — Very Fast: Hard to Stand in the Current
- ☐ 3 pt — Fast: Quickly Takes Objects Downstream
- ☐ 1 pt — Moderate: Slowly Takes Objects Downstream
- ☐ 1 pt — Slow: Flow Nearly Absent
- ☐ 0 pt — None

VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) Score: _____

a) Riffles/Runs Are:

- ☐ 8 pt — Knee Deep or Deeper & Fast
- ☐ 6 pt — Ankle/Calf Deep & Fast
- ☐ 4 pt — Ankle Deep or Less & Slow
- ☐ 0 pt — Do Not Exist

b) Riffle/Run Substrates Are:

- ☐ 7 pt — Fist Size or Larger
- ☐ 4 pt — Smaller Than Fist Size, but Larger Than Fingernail
- ☐ 0 pt — Smaller Than Your Fingernails or Do Not Exist

Date: 3-1-04

Citizens Qualitative Habitat Evaluation Index

85.5 CQHEI Total

Vol ID: 1000 Site ID: 1000 River and Watershed: ** EXAMPLE ! **

I. Substrate (Bottom Type) Score: 20

a) Size

- [ ] 14 pt Mostly Large (Fist Size or Bigger)
- [ ] 6 pt Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock)
- [x] 10 pt Mostly Medium (Smaller than Fist, but Bigger than Fingernail)
- [ ] 0 pt Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky)

b) "Smothering"

- [x] NO 5 pt Are Fist Size and Larger Pieces Smothered By Sands/Silts?
- [ ] YES 0 pt

Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects

c) "Silting"

- [x] NO 5 pt Are Silts and Clays Distributed Throughout Stream?
- [ ] YES 0 pt

Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two

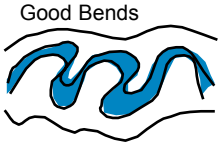
II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present Score: 14

- [x] 2 pt Underwater Tree Roots (Large)
- [ ] 2 pt Boulders
- [x] 2 pt Downed Trees, Logs, Branches
- [ ] 2 pt Water Plants
- [ ] 2 pt Undercut Banks
- [x] 2 pt Underwater Tree Rootlets (Fine)
- [x] 2 pt Backwaters, Oxbows or Side Channels
- [x] 2 pt Shallow, Slow Areas for Small Fish
- [x] 2 pt Deep Areas (Chest Deep)
- [x] 2 pt Shrubs, Small Trees that Hang Close Over the Bank

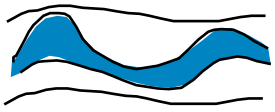
III. Stream Shape and Human Alterations Score: 15

a) "Curviness" or "Sinuousity" of Channel

- [ ] 8 pt 2 or More Good Bends



- [x] 6 pt 1 or 2 Good Bends



- [ ] 3 pt Mostly Straight Some "Wiggle"

- [ ] 0 pt Very Straight

b) How Natural Is The Site?

- [ ] 12 pt Mostly Natural
- [ ] 6 pt Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders)
- [x] 9 pt A Few Minor Man-made Changes (e.g., a bridge, some streambank changes)
- [ ] 0 pt Heavy, Man-made Changes (e.g., leveed or channelized)

IV. Stream Forests & Wetlands (Riparian Area) & Erosion Score: 13.5

a) Width of Riparian Forest & Wetland - Mostly:

- [x] 8 pt Wide (Can't Throw A Rock Through/ Across It)
- [ ] 5 pt Narrow (Can Throw A Rock Through/ Across It)
- [x] 0 pt None

Avg 4 pts

b) Land Use - Mostly:

- [x] 5 pt Forest/Wetland
- [ ] 4 pt Shrubs
- [ ] 3 pt Overgrown Fields
- [ ] 2 pt Fenced Pasture
- [x] 2 pt Park (Grass)
- [ ] 2 pt Conservation Tillage
- [ ] 1 pt Suburban
- [ ] 1 pt Row Crop
- [ ] 0 pt Open Pasture
- [ ] 0 pt Urban/ Industrial

Avg 3.5 pts

c) Bank Erosion - Typically:

- [x] 4 pt Stable Hard or Well-Vegetated Banks
- [ ] 2 pt Combination of Stable and Eroding Banks
- [ ] 0 pt Raw, Collapsing Banks

d) How Much of Stream is Shaded?

- [ ] 3 pt Mostly
- [x] 2 pt Partly
- [ ] 0 pt None

V. Depth & Velocity Score: 13

a) Deepest Pool is At Least:

- [x] 8 pt Chest Deep
- [ ] 4 pt Knee Deep
- [ ] 6 pt Waist Deep
- [ ] 0 pt Ankle Deep

b) Check ALL The Flow Types That You See (Add Points):

- [ ] 2 pt Very Fast: Hard to Stand in the Current
- [x] 3 pt Fast: Quickly Takes Objects Downstream
- [x] 1 pt Moderate: Slowly Takes Objects Downstream
- [x] 1 pt Slow: Flow Nearly Absent
- [x] 0 pt None

VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) Score: 10

a) Riffles/Runs Are:

- [ ] 8 pt Knee Deep or Deeper & Fast
- [x] 6 pt Ankle/Calf Deep & Fast
- [ ] 4 pt Ankle Deep or Less & Slow
- [ ] 0 pt Do Not Exist

b) Riffle/Run Substrates Are:

- [ ] 7 pt Fist Size or Larger
- [x] 4 pt Smaller Than Fist Size, but Larger Than Fingernail
- [ ] 0 pt Smaller Than Your Fingernails or Do Not Exist

Site Map and Stream Flow

Two components of the original Site Survey Data Sheet are not included in the Citizens Qualitative Habitat Evaluation Index (CQHEI): the Stream Site Map and Stream Flow Calculations. These are completed at your site within the same 200 foot stream segment.

Site Map

Drawing a map of your site location is an excellent first step in getting to know your 200 foot stream segment. Looking at an aerial photograph before or during your visit may also help with familiarization. Continuing this tradition on an annual basis may also alert you to changes at your site that may not have been obvious during regular sampling visits. The data sheet is on Page 26 An example map is shown below in Figure 10. The stream map cannot be entered into the Volunteer Monitoring Internet Database.

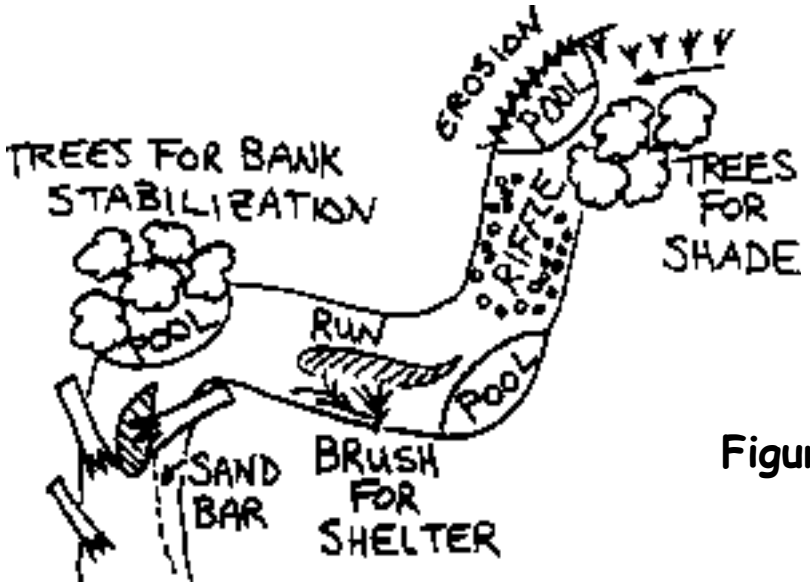


Figure 10

Stream Flow Calculations

A work sheet is provided on Page 27 to assist volunteers in determining the stream flow or discharge rate. (See page 28 for a completed example.) Discharge is the amount (volume) of water flowing in the stream per second. This measurement is important because it influences other physical, chemical, and biological factors in the stream (i.e., all of our other tests!). A high discharge rate may indicate recent rainfall or snowmelt events. When a large amount of rain runs off the land, it often carries sediments and nutrients to the stream. Very low discharge rates may indicate drought conditions, which also affect water quality and aquatic life. The discharge rate is obtained by multiplying the average width, depth, and velocity of the stream. All measurements are taken (or converted) into feet. The data sheet includes a diagram and instructions. Stream flow calculations can be entered into the Volunteer Monitoring Internet Database (See Chapter 7).

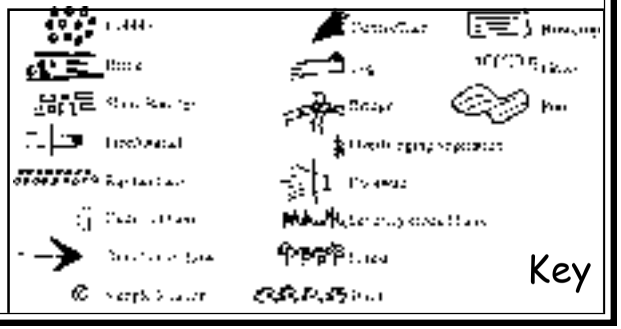
Average Width (W) - width of the stream (the water itself) taken from where it touches the stream bank on one side to where it touches the stream bank on the other side - take three width measurements; when possible measure areas that appear most representative of the entire 200 foot stream section

Average Depth (Z) - three depth measurements are taken (using a yardstick) across the stream on three transects - nine total measurements

Average Velocity (V) - how fast the water is moving - measure a distance and time how long it takes an apple or orange to float the distance - repeat three times

Roughness Coefficient (n) - select 0.8 for a gravel or rocky bottom; select 0.9 for sandy, muddy or bedrock

Stream Site Map



Hoosier Riverwatch Stream Flow Calculation Worksheet

1. River Width (W)

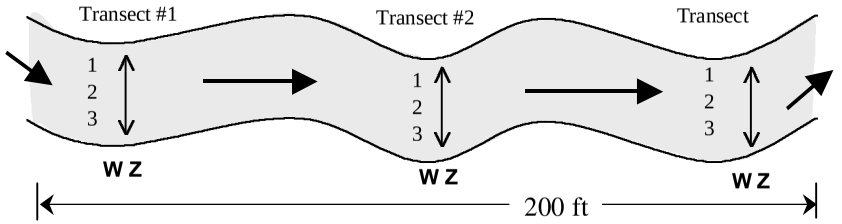
(One measurement at each transect.)

Transect #	Width (ft)
(1)	
(2)	
(3)	
Average Width (W)	

2. River Depth (Z)

(Three measurements along each transect.)

	Transect 1 (ft)	Transect 2 (ft)	Transect 3 (ft)	
(1)				
(2)				
(3)				
Average Depth (Z)				



3. Surface Velocity(V) = Length/Time

(Allow the object to attain velocity before timing it.)

	Length (ft)	Time (sec)	Velocity ft/sec
(1)			
(2)			
(3)			
Average Velocity (V)			

Unit Conversions
1 in = 0.0833 ft
1 m = 3.281 ft

4. Stream Flow = Discharge (D)

Avg. Width (W)		feet
Avg. Depth (Z)		feet
Avg. Velocity (V)		feet/sec
*(n) = 0.9 or 0.8		none
Discharge (D)		ft^3/s = (cfs)

Multiply W x Z x V x n = D

*n is a constant indicating roughness of substrate - use 0.9 for sandy, muddy bottom or bedrock; use 0.8 for gravel or rocky bottom

Convert measurements of feet + inches to 10^{ths} of feet. **Example: 10 ft + 4 in = 10.33 ft**. (Multiply 4 inches x 0.0833 feet/inch = 0.3332 ft. Add this to 10 feet = 10.33 feet.)

Hoosier Riverwatch Stream Flow Calculation Worksheet

EXAMPLE

1. River Width (W)

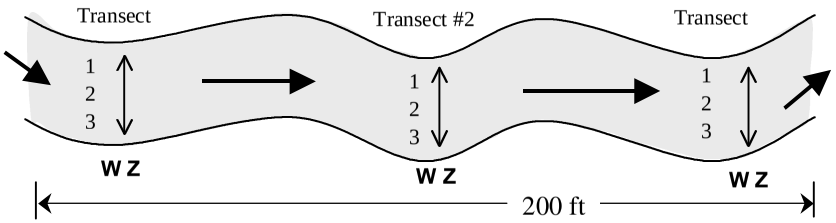
(One measurement at each transect.)

Transect #	Width (ft)	
(1)	10.33	(10 ft, 4 in)
(2)	9.67	(9 ft, 8 in)
(3)	11	(11 ft)
Average Width (W)	**10.33 ft**	

2. River Depth (Z)

(Three measurements along each transect.)

	Transect 1 (ft)	Transect 2 (ft)	Transect 3 (ft)	
(1)	0.83 (10 in)	1 ft	1.54 (1 ft, 6.5 in)	
(2)	1.42 (1 ft, 5 in)	1.58 (1ft, 7 in)	1.11 (1 ft, 0.33 in)	
(3)	1.08 (1 ft, 1 in)	0.58 (7 in)	1.33 (1 ft, 4 in)	
Average Depth (Z)	1.39 ft	1.05 ft	1.33 ft	**1.26 ft**



3. Surface Velocity(V) = Length/Time

(Allow the object to attain velocity before timing it.)

	Length (ft)	Time (sec)	Velocity ft/sec
(1)	10	25	0.4
(2)	10	28	0.36
(3)	10	26	0.38
	Average Velocity (V)		**0.38**

Unit Conversions
1 in = 0.0833 ft
1 m = 3.281 ft

4. Stream Flow = Discharge (D)

Avg. Width (W)	10.33	feet
Avg. Depth (Z)	1.26	feet
Avg. Velocity (V)	0.38	feet/sec
*(n) = 0.9 or 0.8	0.8	none
Discharge (D)	**3.96**	ft^3/s = (cfs)

Multiply W x Z x V x n = D

*n is a constant indicating roughness of substrate - use 0.9 for sandy, muddy bottom or bedrock; use 0.8 for gravel or rocky bottom

Convert measurements of feet + inches to 10^{ths} of feet. **Example: 10 ft + 4 in = 10.33 ft.** (Multiply 4 inches x 0.0833 feet/inch = 0.3332 ft. Add this to 10 feet = 10.33 feet.)